

# RENEWABLE ENERGY: RESOURCES AND INTEGRATION

A 2-Day training course on the emerging low emissions electricity industry

28-29 March 2019 • Perth

23-24 May 2019 • Melbourne

24-25 October 2019 • Sydney

28-29 November 2019 • Brisbane



## Our Expert Course Instructor



### Dr Hugh Outhred

Hugh has delivered 130 training courses in 15 countries on electricity industry design and renewable energy integration for participants from governments, non-government organisations, the electricity supply industry and private industry.

## Key Learning Objectives

- ▶ Renewable energy resources at global and Australian levels (solar, wind, biomass, hydro, geothermal, marine)
- ▶ Technologies for converting renewable energy resources to electrical energy
- ▶ Energy storage technologies for electricity industry applications
- ▶ Opportunities and techniques for demand-side flexibility
- ▶ Other complementary resources that can facilitate renewable energy integration
- ▶ Challenges in integrating renewable energy resources and their resolution: technical, commercial, planning & regulation
- ▶ Experience to date in deploying renewable energy and energy storage technologies in the Australian National Electricity Market and elsewhere
- ▶ Lessons learned and future directions

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## ABOUT THE COURSE

The course will provide a comprehensive overview of renewable energy resources and their integration into the electricity industry, with a particular focus on wind and solar energy and their integration into the Australian National Electricity Market.

Our expert instructor will describe the main renewable energy resources, their distribution in Australia and elsewhere and the technologies that are used to convert renewable energy resources into electrical energy. He will also describe complementary resources including energy storage, flexible demand and flexible conventional generation that can facilitate renewable energy integration.

The course will then discuss wind and solar PV integration in more detail, considering temporal and locational aspects, technical and safety standards and economic and commercial aspects. Relevant current energy policy settings will be considered.

## WHO WILL BENEFIT

Managers, executives and staff from the electricity, gas, renewable energy and storage industries, regulatory bodies and government, banks, brokers, lawyers, consultants, industry advisors, major energy users and other industry professionals seeking more knowledge about the current electricity industry and future trends.



Would You Like To Run This Course On-Site?

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## OUR EXPERT COURSE INSTRUCTOR



**Dr Hugh Outhred**

Hugh Outhred is the Managing Director of Ipen Pty Ltd, a company established in 1998 to provide independent perspectives on energy, society and the environment. Hugh holds a PhD in Electrical Engineering from the University of Sydney and is a Fellow of the Australian Institute of Energy.

Since 1988, Hugh has provided advice to governments, non government organisations, the electricity supply industry and private industry and delivered 130 training courses in 15 countries on electricity industry design and renewable energy integration for participants from governments, non government organisations, the electricity supply industry and private industry.

Hugh has contributed to the theory of electricity industry design since 1979 and to its practical implementation in Australia since the 1980's. In 1985 and 1986, he was seconded to the government of New South Wales as an advisor on electricity competition and sustainability. In 1995 and 1996, he led a project for the National Grid Management Council to undertake electricity trading experiments to trial the proposed National Electricity Market trading rules prior to their formal implementation. In 1997, he was appointed as an inaugural member of the NSW Licence Compliance Advisory Board, a position he held until the Board was replaced as part of revised industry governance arrangements in 2001 and in 1998 he was appointed as an inaugural member of the Australian National Electricity Tribunal - a position he held until the Tribunal was replaced as part of revised industry governance arrangements in 2006. In 2008, Hugh was a Lead Author for the IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation, which was published in 2011.

Hugh retired from the School of Electrical Engineering and Telecommunications at the University of New South Wales in September 2007 from the positions of inaugural Presiding Director of UNSW's Centre for Energy and Environmental Markets and Head, Energy Systems Research Group in the School of Electrical Engineering and Telecommunications.

Hugh was a Fulbright Senior Fellow at the University of California Berkeley in 1994 and has held visiting positions at Massachusetts Institute of Technology in the USA, the University of Liverpool in the UK, the Universidad Pontificia Comillas in Spain, Roskilde University Centre in Denmark and Murdoch University in Perth. He has been a Board member of the Australian Cooperative Research Centre for Renewable Energy, an Associate Director of UNSW's Centre for Photovoltaic Devices and Systems and a member of CSIRO's Energy Flagship Advisory Committee.

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## 2-Day Course Outline

### Renewable energy resources and conversion technologies for electricity generation

- Renewable energy resources in the global & Australian contexts – what are the key resources and where are they located?
- Renewable energy electricity generation technologies – what are their characteristics and development trajectories and how do they compare to non-renewable generation technologies?
- Complementary resources that can facilitate renewable energy integration: energy storage, flexible demand and flexible conventional generation
- Comparison of power electronic interfaced generators with turbo-alternators with respect to inertia, fault-level and short-term dynamic behaviour and implications for power system operation
- Where do wind & solar PV fit into the broader renewable energy picture?

### Renewable energy integration as a process of technological and societal innovation and acculturation

- What do we mean by socio-technological innovation and societal acculturation?
- How can we apply these ideas to renewable energy integration?
- How do integration challenges vary with renewable energy type, electricity industry scale and national context? Where do wind & solar PV fit?
- Electricity industry observability, predictability & controllability: data acquisition, communication, analysis and control
- Can “smart grid” and “microgrid” concepts help in renewable energy integration?

### Temporal aspects of wind & solar PV integration

- Temporal characteristics of wind & solar PV resources and implications for their integration into the electricity industry
- Implications of the absence of inertia and other characteristics of power electronic interfaced devices: generators, energy storage and end-use devices
- The role of forecasting in predicting future wind & solar PV production: to what extent are they predictable?
- Complementary resources and their role in facilitating wind & solar integration: flexible conventional generation, demand-side flexibility & reversible energy storage
- Role for system operators, energy markets and ancillary services in managing temporal aspects of wind & solar integration

### Locational aspects of wind & solar PV integration:

- The effects of network losses and network flow constraints
- Implications of embedded generators & low fault currents for power system protection & voltage control
- Connection requirements for wind & solar PV, including technical and safety standards
- The role of network control ancillary services in managing network impacts
- The role of governments and regulators in resolving network-related issues

### Planning procedures and safety issues for renewable energy projects

- Planning approval processes for renewable energy projects and “best practice” guidelines
- Safety issues associated with renewable energy projects – mechanical failure, fire and electrocution, batteries

### Case study: Wind & solar PV integration in the Australian National Electricity Market (NEM)

- Renewable energy generator status in the NEM wholesale market – scheduled, semi-scheduled or non-scheduled; market or non-market
- Rooftop solar PV and other small renewable generators in the retail market
- The role of energy and frequency control ancillary service (FCAS) spot and derivative markets in managing temporal variability and uncertainty in the NEM
- Planning processes in the NEM
- Cash flows associated with the National Electricity Market – spot energy and FCAS markets and associated derivative markets, network services cash flows & retail markets
- The Australian Wind & Solar Energy Forecasting Systems
- Experience to date with microgrids
- Recent policy developments including the Finkel Report outcomes, government initiatives and current work by AEMO, AEMC and AER.



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**2 Telephone**  
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## Stay Connected



## Renewable Energy: Resources and Integration

	Location	Course Dates	Super Early Bird price valid until		Early Bird price valid until		Standard price valid after		4+ Dels Discount	
			PE - 15 Feb 19 ME - 12 Apr 19 SY - 13 Sep 19 BR - 18 Oct 19		PE - 8 Mar 19 ME - 3 May 19 SY - 4 Oct 19 BR - 8 Nov 19		PE - 8 Mar 19 ME - 3 May 19 SY - 4 Oct 19 BR - 8 Nov 19			
P19GT18PE	Perth	28-29 Mar 19	\$2,595 + \$259.50 GST	<b>\$2,854.50</b>	\$2,795 + \$279.50 GST	<b>\$3,074.50</b>	\$2,895 + \$289.50 GST	<b>\$3,184.50</b>	\$2,236 + \$223.60 GST	<b>\$2,459.60</b>
P19GT18ME	Melbourne	23-24 May 19	\$2,595 + \$259.50 GST	<b>\$2,854.50</b>	\$2,795 + \$279.50 GST	<b>\$3,074.50</b>	\$2,895 + \$289.50 GST	<b>\$3,184.50</b>	\$2,236 + \$223.60 GST	<b>\$2,459.60</b>
P19GT18SY	Sydney	24-25 Oct 19	\$2,595 + \$259.50 GST	<b>\$2,854.50</b>	\$2,795 + \$279.50 GST	<b>\$3,074.50</b>	\$2,895 + \$289.50 GST	<b>\$3,184.50</b>	\$2,236 + \$223.60 GST	<b>\$2,459.60</b>
P19GT18BR	Brisbane	28-29 Nov 19	\$2,595 + \$259.50 GST	<b>\$2,854.50</b>	\$2,795 + \$279.50 GST	<b>\$3,074.50</b>	\$2,895 + \$289.50 GST	<b>\$3,184.50</b>	\$2,236 + \$223.60 GST	<b>\$2,459.60</b>

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If you have 8+ interested people, an on-site course can be the ideal solution – giving you the opportunity to customise our course content to your specific training needs, as well as attracting significant savings compared to public course costs.

### Why Choose On-site With Informa Corporate Learning?

- 1. Custom design** – Together, we will identify the best blended learning solution for your culture, your people and your training objectives.
- 2. Quality Assured** – We design market-leading training programs, concepts and methodologies, with a 400+ course portfolio. Our rigorously selected 900+ instructor faculty are recognised experts in their field. Quality of their content and delivery methods is assured through continuous monitoring and evolution.
- 3. On-site training** is a cost effective way to train your people and achieve your defined outcomes.

### Our Long Standing Clients Include:

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